

- Sub
D₁
- a¹
- b. receiving and recording a plurality of seismic traces responsive to and representative of the acoustic waves propagating through the fractured zone wherein a first portion of the seismic traces corresponds to a first window located above the fractured zone in the formation, and a second portion of the seismic traces corresponds to a second window located below the fractured zone in the formation;
 - c. generating a first frequency spectrum associated with the first portion of the seismic traces corresponding to the first window;
 - d. generating a second frequency spectrum associated with the second portion of the seismic traces corresponding to the second window;
 - e. superimposing the first frequency spectrum onto the second frequency spectrum thereby generating a superimposed frequency spectrum and defining from the superimposed frequency spectrum a low frequency and a high frequency;
 - f. when the low frequency and the high frequency is defined, further defining from the superimposed frequency spectrum a plurality of amplitude values, the plurality of amplitude values including: an amplitude $F_a(\text{high})$ of the first frequency spectrum at the defined high frequency, an amplitude $F_a(\text{low})$ of the first frequency spectrum at the defined low frequency, an amplitude of the second frequency spectrum $F_b(\text{high})$ at the defined high frequency, and an amplitude $F_b(\text{low})$ of the second frequency spectrum at the defined low frequency;
 - g. from the plurality of amplitude values, defining a t^* attribute by subtracting the natural log of the ratio of $F_a(\text{low})$ to $F_b(\text{low})$ from the natural log of the ratio of $F_a(\text{high})$ to $F_b(\text{high})$ to get a numerator and dividing the numerator by a denominator which comprises the defined high frequency less the defined low frequency;

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a1
Conc'd Sub D1

h. plotting the t^* attribute on a map and assigning a unique color to the t^* attribute.

2 5. (Amended) A program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for detecting fractures in a fractured zone in an Earth formation, the method steps comprising:

- Sub D1*
- a2*
- a. operating on a plurality of received and recorded seismic traces, responsive to and representative of a plurality of acoustic waves propagating through the fractured zone and reflecting off a horizon in the formation, to define a first portion of the seismic traces corresponding to a first window located above the fractured zone in the formation, and to define a second portion of the seismic traces corresponding to a second window located below the fractured zone in the formation;
 - b. generating a first frequency spectrum associated with the first portion of the seismic traces corresponding to the first window;
 - c. generating a second frequency spectrum associated with the second portion of the seismic traces corresponding to the second window;
 - d. superimposing the first frequency spectrum onto the second frequency spectrum thereby generating a superimposed frequency spectrum and defining from the superimposed frequency spectrum a low frequency and a high frequency;
 - e. when the low frequency and the high frequency are defined, further defining from the superimposed frequency spectrum a plurality of amplitude values, including an amplitude $F_a(\text{high})$ of the first frequency spectrum at the defined high frequency, an amplitude $F_a(\text{low})$ of the first frequency spectrum at the defined low frequency, an amplitude of the second frequency spectrum $F_b(\text{high})$ at the defined high frequency, and an amplitude $F_b(\text{low})$ of the second frequency spectrum at the defined low frequency;

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17

A

- A2
Conc'd
Sub D1
- f. from the plurality of amplitude values, defining a t^* attribute by subtracting the natural log of the ratio of $F_a(\text{low})$ to $F_b(\text{low})$ from the natural log of the ratio of $F_a(\text{high})$ to $F_b(\text{high})$ to get a numerator and dividing the numerator by a denominator which comprises the defined high frequency less the defined low frequency; and
- g. plotting the t^* attribute on a map and assigning a unique color to the t^* attribute.

3/ (Amended) An apparatus adapted for detecting fractures in a fractured zone in an Earth formation, the apparatus comprising:

- Sub D1
- A3
- a. a first means for operating on a plurality of received and recorded seismic traces, responsive to and representative of a plurality of acoustic waves propagating through the fractured zone and reflecting off a horizon in the formation, to define a first portion of the seismic traces corresponding to a first window located above the fractured zone in the formation, and to define a second portion of the seismic traces corresponding to a second window located below the fractured zone in the formation;
- b. a second means to generate a first frequency spectrum associated with the first portion of the seismic traces corresponding to the first window and to generate a second frequency spectrum associated with the second portion of the seismic traces corresponding to the second window;
- c. a third means for superimposing the first frequency spectrum onto the second frequency spectrum thereby generating a superimposed frequency spectrum and defining from the superimposed frequency spectrum a low frequency and a high frequency;
- d. a fourth means for further defining, from the superimposed frequency spectrum, a plurality of amplitude values when the low frequency and the high frequency is

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